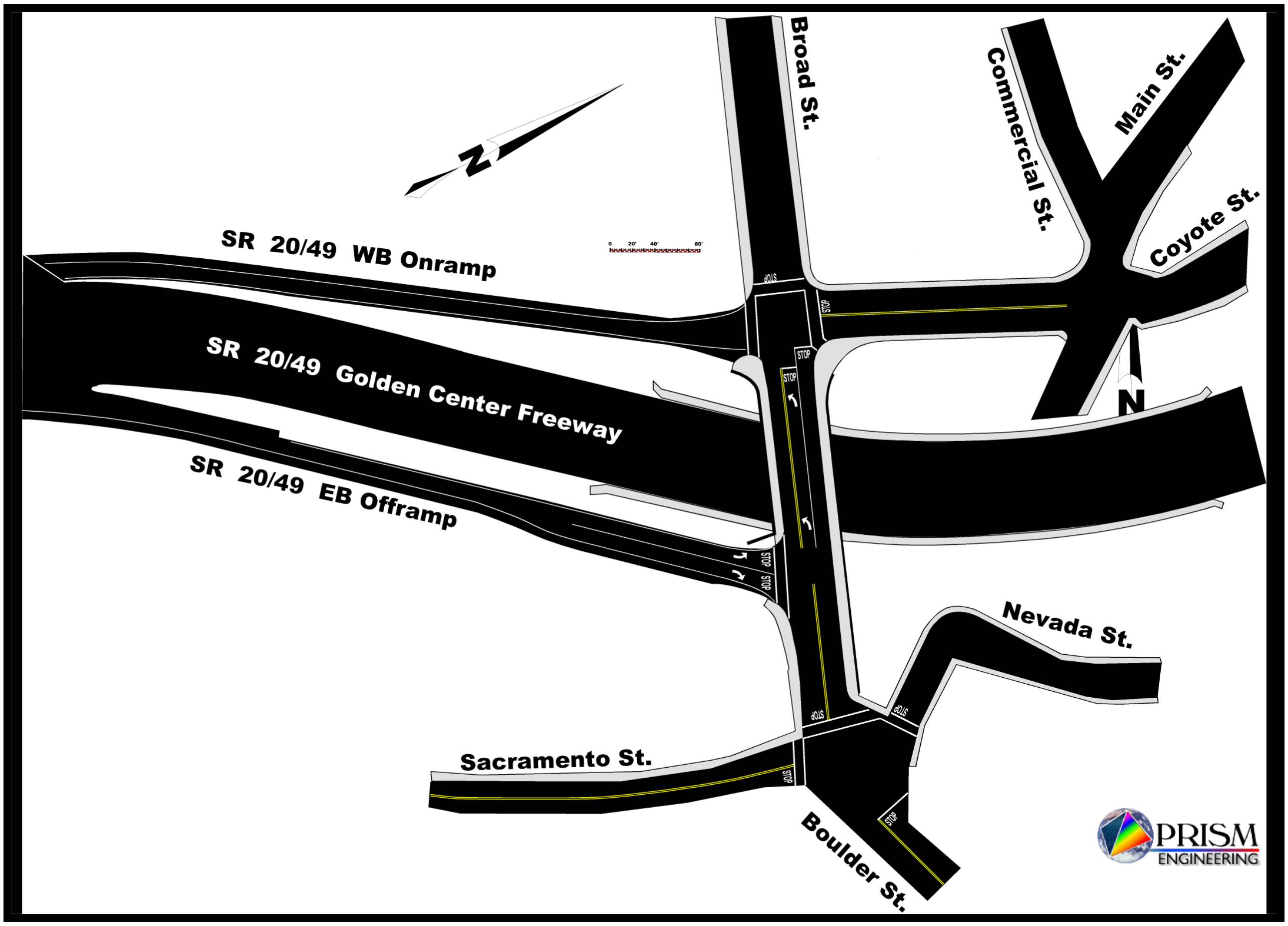
FINAL REPORT



BROAD STREET INTERSECTION STUDY

Prepared for
THE CITY OF NEVADA

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Executive Summary

Broad Street

Broad Street in the City of Nevada has specific design inefficiencies at its intersection with the SR 20/49 WB onramp. These include

- The entrance throat for the onramp is extra wide (40 feet at opening). This enables wide sweeping turns to the onramp from the bridge, which makes it more difficult for pedestrians to know whether a vehicle is intending to go on the ramp or go straight. In other words, it can create an unsafe condition for a pedestrian already in the crosswalk.
- There is no stop control on the northbound Broad Street approach (this is an inefficiency for pedestrian traffic as well as all other side street traffic entering Broad Street or the onramp, as it gives all right-of-way to the traffic already on the bridge)

These design choices were made decades ago when the Golden Center Freeway was initially constructed, and the movement of vehicles large and small was of primary concern. The existing condition at this location makes it difficult for pedestrian traffic to cross because the crosswalks parallel to Broad Street are very long, and the approach speed of the vehicles crossing those crosswalks from the Broad Street bridge is higher than it needs to be.

Union Street

This short segment of street connects Broad Street to the Main Street / Coyote Street / Commercial Street intersection. There is no crosswalk in this section between Broad Street and Commercial Street. Traffic often backs up on Union Street as vehicles wait to gain access to Broad Street. This line of traffic prevents vehicles from easily leaving the bank parking lot (see Figure -2). It also makes it difficult for pedestrians to cross Union Street due to the line of cars that typically takes place during peak hour time periods.

Mitigation

In this study it was determined that the intersection could be redesigned to calm traffic and slow traffic speeds down. In addition, it is possible to shorten the length of both crosswalks parallel to Broad Street to get pedestrians across the road faster. Figure E-1 shows the Broad Street and

SR 20/49 westbound onramp intersection for the existing and proposed conditions in a side-by-side comparison.

As shown in the figure, it is proposed to increase the reach of the sidewalks on both sides of the Broad Street bridge, to lessen the area that vehicles may use to turn left onto the freeway, or turn right towards downtown. By increasing the sidewalks it is possible to give pedestrians a shorter painted crosswalk, and to have vehicles slow speeds. In fact, it is possible to create a second lane for the northbound direction so that a separate left turn pocket can be used, with stop sign control for each. This will put the right-of-way in an equal access mode, and further lessening confusion of motorists at this intersection.

The Union Street mitigation is depicted in Figure E-2, which shows a new pedestrian crosswalk installation at the north end of Union Street at Commercial Street. This crosswalk will give pedestrians the right-of-way they need to safely cross the street, even if lines of cars form. It should be noted that with the installation of stop signs on the Broad Street bridge approach towards downtown, that this will allow Union Street traffic to get onto Broad Street much easier, and will clear the lines of traffic on Union Street.

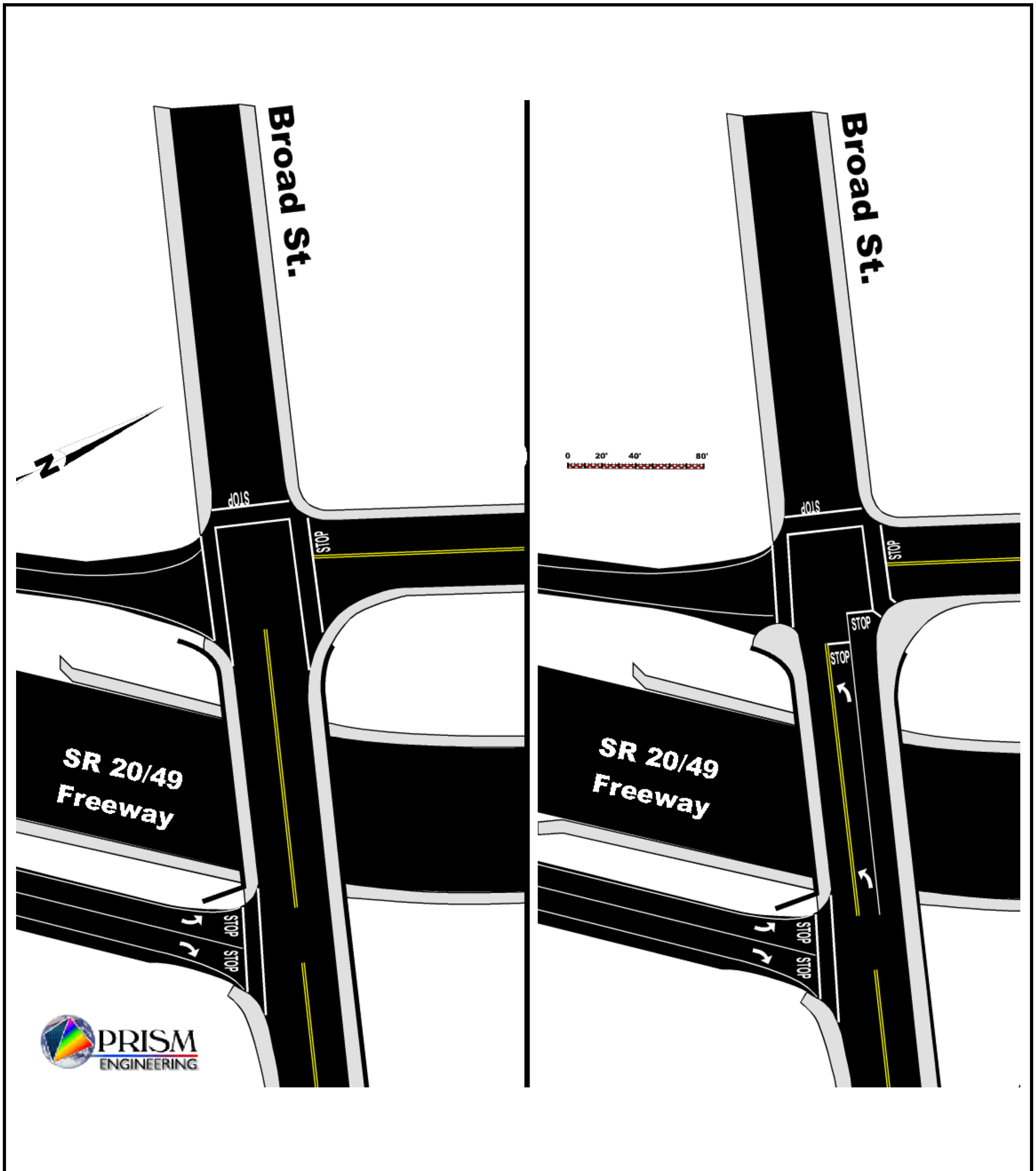


Figure E-1 Broad Street Existing Conditions vs. Proposed Changes

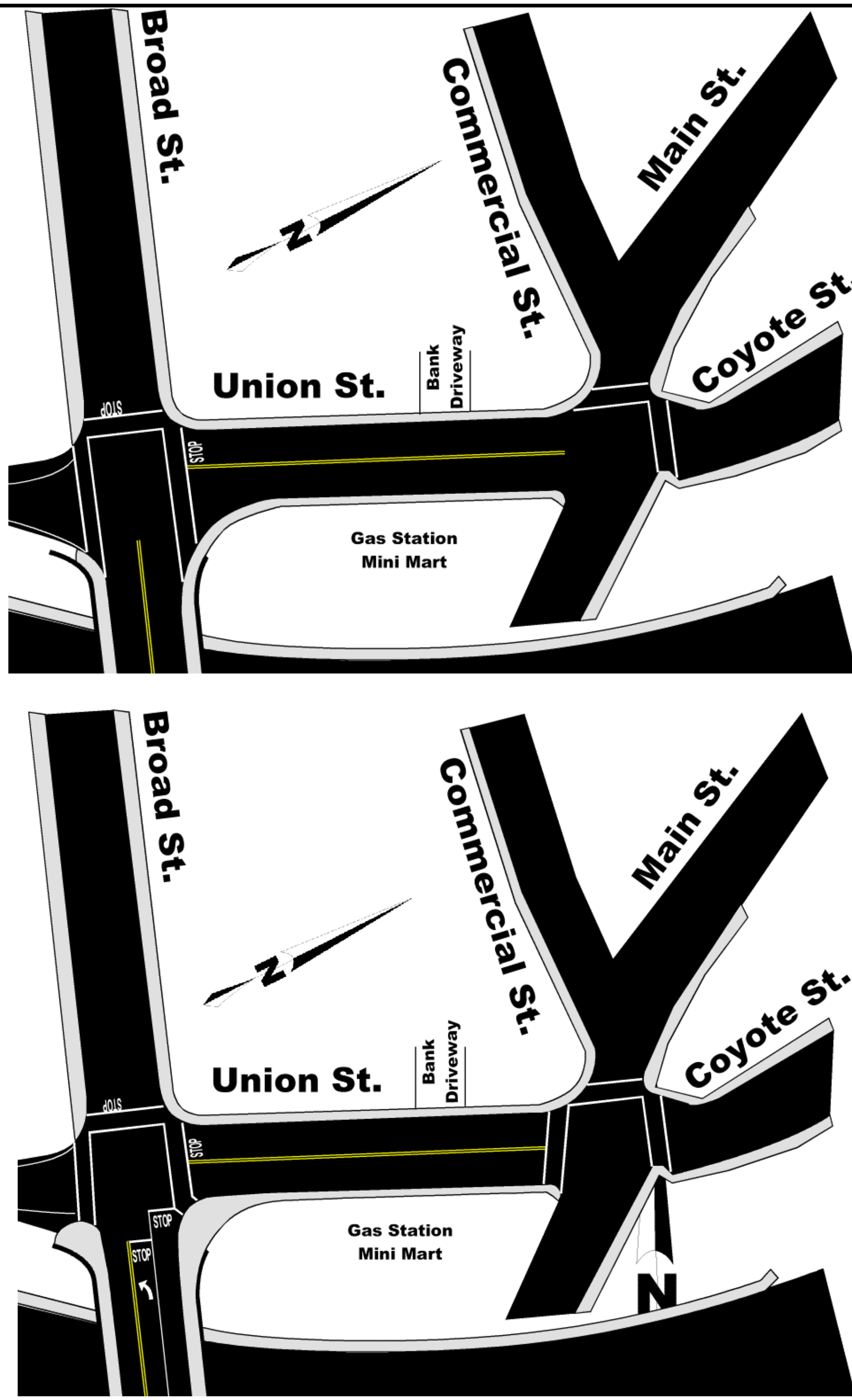


Figure E-2 Union Street Existing Conditions vs. Proposed Changes

Introduction

One of the major roadways in the City of Nevada is Broad Street. This street is the primary traffic carrier through the downtown core area of the City, and also has direct access to the Golden Center Freeway system with an eastbound offramp and a westbound onramp. Broad Street crosses the Gold Center Freeway (SR 20/49) with a short bridge. The distance on the bridge between intersections is approximately 200 feet. There is no stop control for any traffic on the bridge, but the eastbound offramp traffic is stop sign controlled. Figure 1 is a vicinity map of the study area showing the freeway, the ramps, the Broad Street bridge and other roadways nearby.

Because the spacing of the intersections on the Broad Street bridge is so close (200 feet), there is the potential that traffic operations could break down should traffic volumes increase significantly in the future. It is easier to keep the freeway offramp from backing up if traffic can get off the ramp to enter the bridge. This is best accomplished by keeping the bridge clear of traffic, and thus the lack of a stop sign on the bridge to slow this movement.

The side-effect of this traffic control decision by Caltrans has been to make it more difficult for Nevada City traffic and pedestrians to enter Broad Street, especially at the Broad Street / SR 20/49 westbound onramp intersection. The geometric design at this intersection as well lends itself to higher speed traffic movements, because the turning radii at the corners coming off the bridge are very large, compared to the downtown side of the intersection (60 foot radius compared to a 25 foot radius).

The reason that it is difficult for pedestrians is because of the extra long crosswalk distances due to the larger turn radii, and because of the higher speeds of the vehicles turning left or right from the bridge. Both of these movements cross over the pedestrian crosswalks at angles, a potential safety issue with drivers and pedestrians challenged at seeing each other.

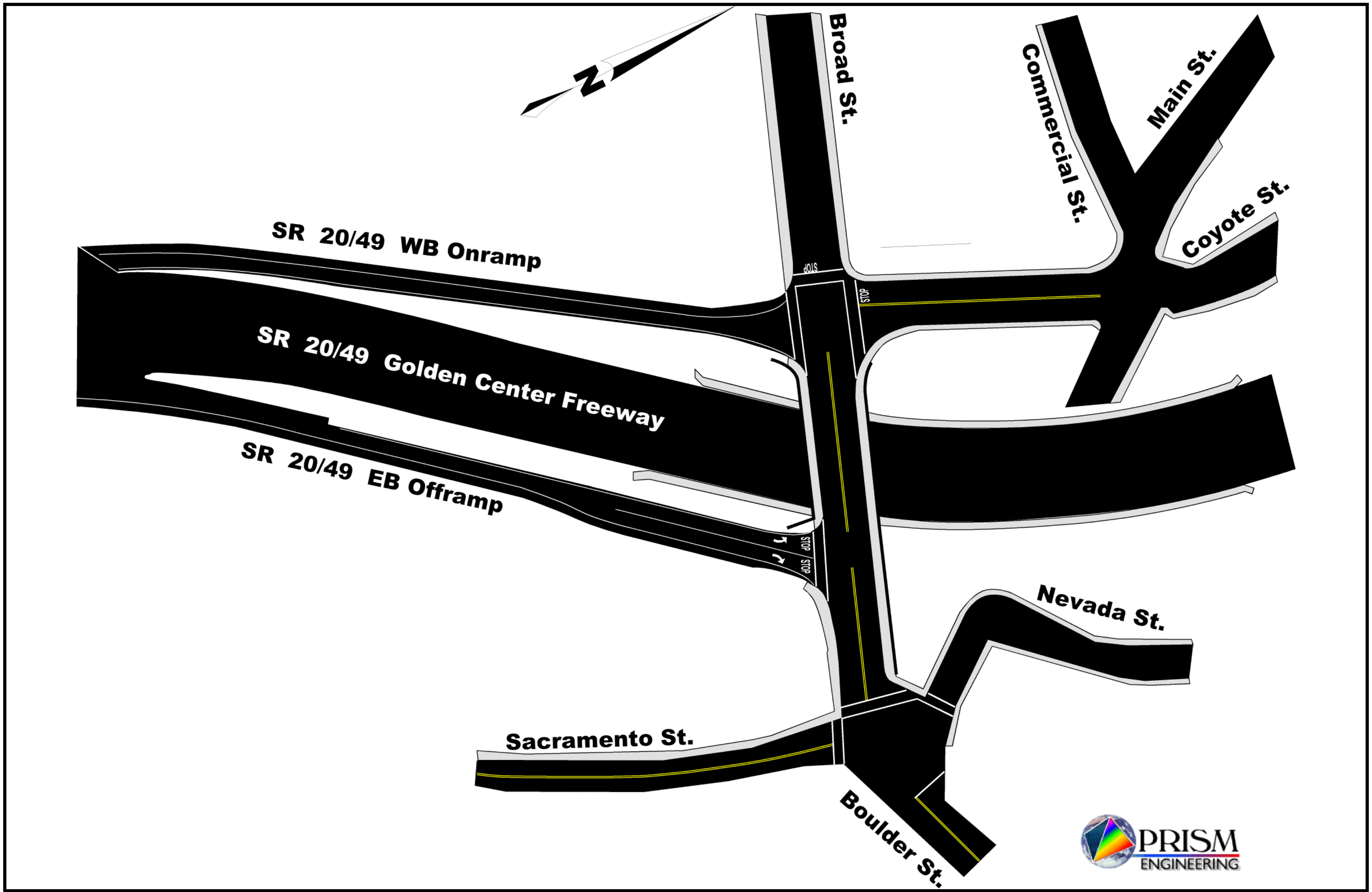


Figure 1 Vicinity Map of Study Area

Looking south onto the Broad Street Bridge. On street parking is allowed on both sides of Broad Street.

Looking north onto the Broad Street bridge. Parking is allowed on the edge of pavement.

Looking south onto the SR 20/49 eastbound offramp. Ramp has two lanes for left and right turn.

Looking north on Broad Street from Sacramento Street. There is a short segment on Broad Street before bridge.

Figure 2A Traffic Observations of Broad Street Bridge Intersections

Looking south onto Union Street from Coyote Street. Bank is on right corner. On street parking is allowed on both sides of street. No crosswalk at north end of Union Street.

Looking north onto Union Street from Broad Street. Union Street drops down in elevation, and has stop sign control for the southbound approach to Broad Street
.

Looking east on Commercial Street towards gas station. This road dead ends at an historical monument.

Looking west from Commercial Street dead end towards Union / Coyote Street intersection.

Figure 2B Traffic Observations of Union Street Intersections

Analysis

The City of Nevada City Police Department supplied video footage of traffic operations at the Broad Street bridge system of intersections. This information was used to determine the peak hour traffic volume at the freeway ramp intersections, and was entered into a traffic engineering software program called Synchro-Pro. This software not only analyzes the traffic volumes, but will simulate traffic vehicles moving on a scaled version of the roadway. Through this software animation it is possible to determine the effectiveness of various traffic control changes, to determine if making a change will cause an improvement or a negative impact to traffic operations.

The existing conditions were modeled in this software using the traffic count data provided by the City. Then some changes were made to traffic control in the software to allow for two northbound lanes on the Broad Street bridge, one of these lanes being a left turn pocket, and the other lane being a through/right lane. The existing cross-section distance from curb to curb is 40 feet, which easily allows for a three lane cross section, if the centerline is adjusted. The centerline was adjusted west to accommodate one southbound lane, and two northbound lanes on the bridge. The two sidewalks on the bridge were also extended northerly as shown in Figure 2 to lessen the radii of these two corners, and significantly shorten the distance of the pedestrian crosswalks. We also added stop sign control to the two new northbound lanes at the intersection with the SR 20/49 onramp to make it easier for pedestrians to cross, and to slow the vehicle speeds.

The result of making these changes to the traffic operation control for the bridge intersections did not adversely affect traffic operations. This is primarily due to a doubling of capacity for the northbound traffic on the bridge by increasing the number of lanes from one lane to two lanes. This was done by more efficiently utilizing the pavement area that was already available on the bridge north of the SR 20/49 eastbound offramp. The results of the traffic analysis using Synchro are given in Tables 2 and 3. The traffic analysis involved inspecting levels of service calculated with state of the art software, and weighing these results with observations in the field. The study intersections include:

Intersection	Status
Broad Street at SR 20/49 onramp	Existing Intersection
Broad Street at SR 20/49 offramp	Existing Intersection

These intersections are all currently unsignalized, and have stop sign control on at least one approach.

Table 1

ICU Level of Service Criteria

LOS and ICU Range	A brief description of the conditions expected for each level of service follows:
LOS A **ICU <= 0.60**	*The intersection has no congestion. A cycle length of 80 seconds or less will move traffic efficiently. All traffic should be served on the first cycle. Traffic fluctuations, accidents, and lane closures can be handled with minimal congestion. This intersection can accommodate up to 40% more traffic on all movements.*
LOS B **0.60 < ICU** **ICU <= 0.70**	*The intersection has very little congestion. Almost all traffic will be served on the first cycle. A cycle length of 90 seconds or less will move traffic efficiently. Traffic fluctuations, accidents, and lane closures can be handled with minimal congestion. This intersection can accommodate up to 30% more traffic on all movements*
LOS C **0.70 < ICU** **ICU <= 0.80**	*The intersection has no major congestion. Most traffic should be served on the first cycle. A cycle length of 100 seconds or less will move traffic efficiently. Traffic fluctuations, accidents, and lane closures may cause some congestion. This intersection can accommodate up to 20% more traffic on all movements.*
LOS D **0.80 < ICU** **ICU <= 0.90**	*The intersection normally has no congestion. The majority of traffic should be served on the first cycle. A cycle length of 110 seconds or less will move traffic efficiently. Traffic fluctuations, accidents, and lane closures can cause significant congestion. Sub optimal signal timings cause congestion. This intersection can accommodate up to 10% more traffic on all movements.*
LOS E **0.90 < ICU** **ICU <= 1.00**	*The intersection is right on the verge of congested conditions. Many vehicles are not served on the first cycle. A cycle length of 120 seconds is required to move all traffic. Minor traffic fluctuations, accidents, and lane closures can cause significant congestion. Sub optimal signal timings can cause significant congestion. This intersection has less than 10% reserve capacity available.*
LOS F **1.00 < ICU** **ICU <= 1.10**	*The intersection is over capacity and likely experiences congestion periods of 15 to 60 minutes per day. Residual queues at the end of green are common. A cycle length over 120 seconds is required to move all traffic. Minor traffic fluctuations, accidents, and lane closures can cause increased congestion. Sub optimal signal timings can cause increased congestion.*

Source: PRISM Engineering, Synchro Pro, and HCM

Analysis Methodology

Synchro 5.0 was utilized to calculate level of service for each of the study intersections. The Synchro software is now capable of analyzing the intersection turning movements using a variety of different “views” of the traffic impacts, so that a better picture of what is taking place can be seen. Reference is made to Table 1 for a summary of the “ICU” level of service criteria used in the analyses.

Interpreting the “ICU” Level of Service

The ICU Level of Service (LOS) gives insight into how an intersection is functioning and how much extra capacity is available to handle traffic fluctuations and incidents. ICU is not a value that can be measured with a stopwatch, but it does give a good reading on the conditions that can be expected at the intersection. This method of LOS rank is best suited for planning analyses, such as are used in traffic impact studies, and more especially for unsignalized intersections. It shows a more conservative LOS based on conditions that are more closely related to available capacity and its utilization, and not delay.

Summary

The level of service before changes is given in Table 2 for the PM peak hour. All intersections operate at LOS C or better conditions on the Broad Street bridge. When the changes are made, the level of service at the Broad Street / SR 20/49 onramp intersection improve to LOS B conditions because of the increase in capacity by doubling the number of northbound lanes from one to two.

Conclusions

It is recommended that the City work with Caltrans District 3 to make modifications to the Broad Street / SR 20/49 westbound onramp intersection geometry so that the proposed changes set forth in this report (See Figures E-1 and E-2) can be implemented. They will improve level of service for vehicles on Broad Street and Union Street, improve the mobility of pedestrians, slow vehicle traffic, and improve access for vehicles entering the Broad Street bridge or the SR 20/49 westbound onramp.

Table 2
PM Peak Hour Analysis Summary
Unmitigated Existing Condition

Study Intersection			PM Peak ICU ratio	PM Peak ICU LOS
1	2Way	Broad Street at SR 20/49 WB onramp	0.75	**C**
2	1Way	Broad Street at SR 20/49 EB offramp	0.44	**A**

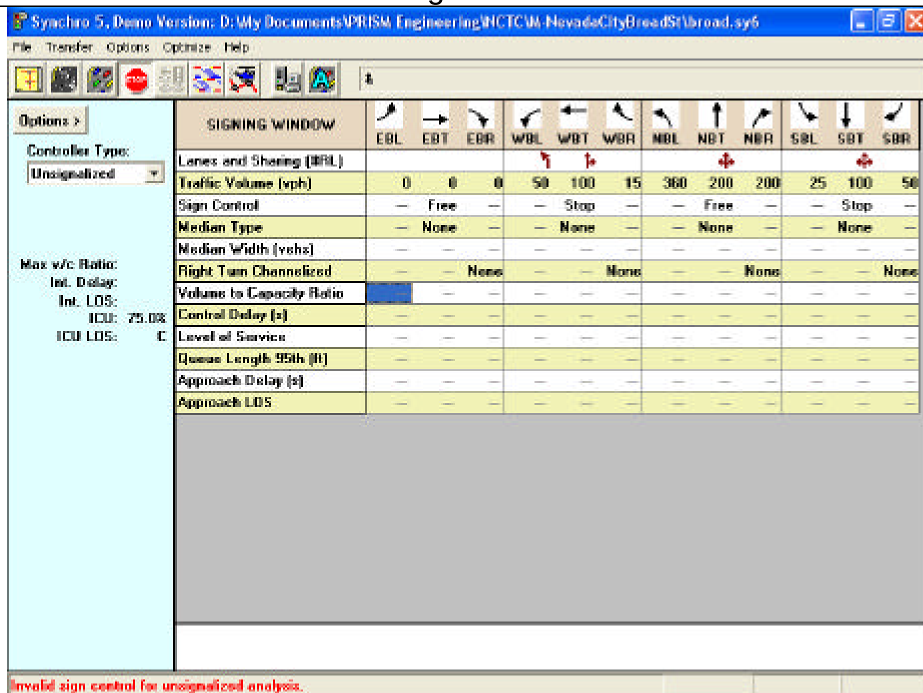
Source: PRISM Engineering

Table 3
PM Peak Hour Analysis Summary
Mitigated Condition

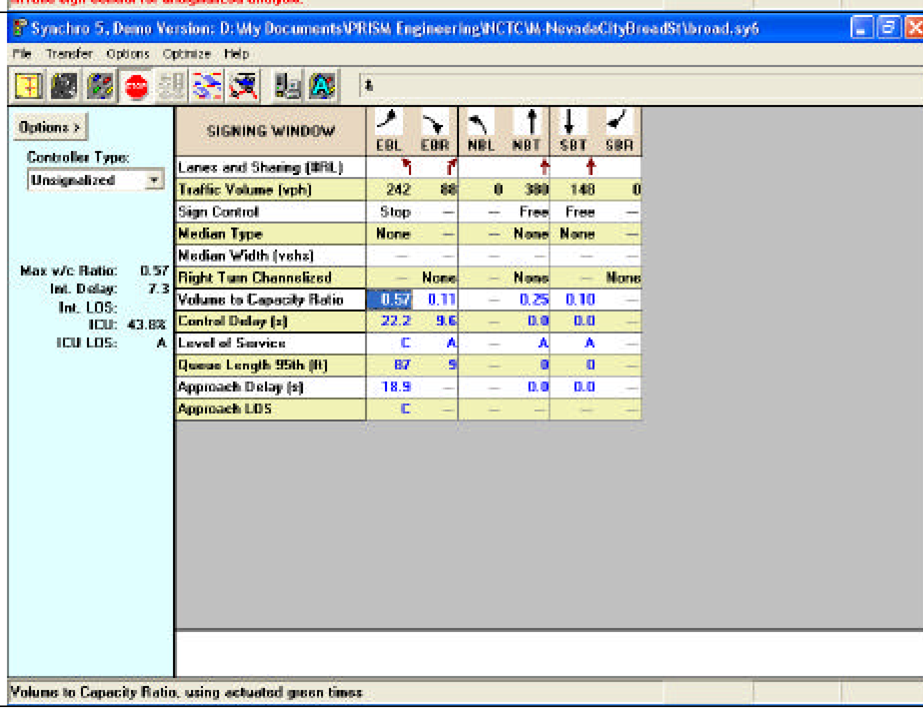
Study Intersection			PM Peak ICU ratio	PM Peak ICU LOS
1	2Way	Broad Street at SR 20/49 WB onramp	0.53	**A**
2	1Way	Broad Street at SR 20/49 EB offramp	0.44	**A**

Source: PRISM Engineering

APPENDIX
Existing Conditions

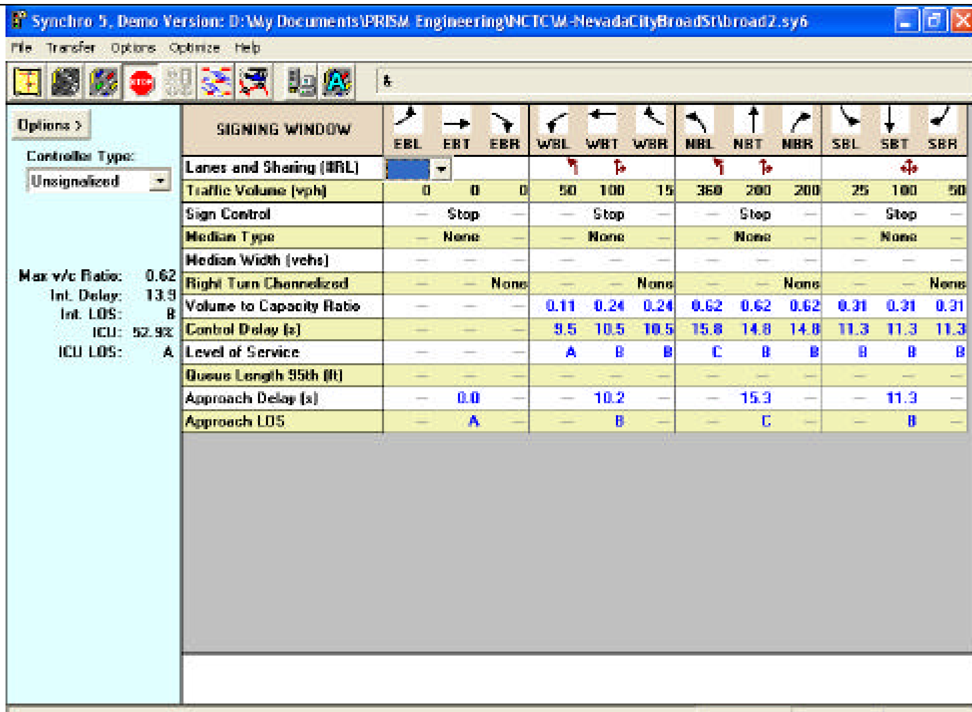


SIGNING WINDOW	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lanes and Sharing (#RL)												
Traffic Volume (vph)	0	0	0	50	100	15	360	200	200	25	100	50
Sign Control	—	Free	—	—	Stop	—	—	Free	—	—	Stop	—
Median Type	—	None	—	—	None	—	—	None	—	—	None	—
Median Width (vehs)	—	—	—	—	—	—	—	—	—	—	—	—
Right Turn Channelized	—	—	None	—	—	None	—	—	None	—	—	None
Volume to Capacity Ratio	—	—	—	—	—	—	—	—	—	—	—	—
Control Delay (s)	—	—	—	—	—	—	—	—	—	—	—	—
Level of Service	—	—	—	—	—	—	—	—	—	—	—	—
Queue Length 95th (ft)	—	—	—	—	—	—	—	—	—	—	—	—
Approach Delay (s)	—	—	—	—	—	—	—	—	—	—	—	—
Approach LOS	—	—	—	—	—	—	—	—	—	—	—	—

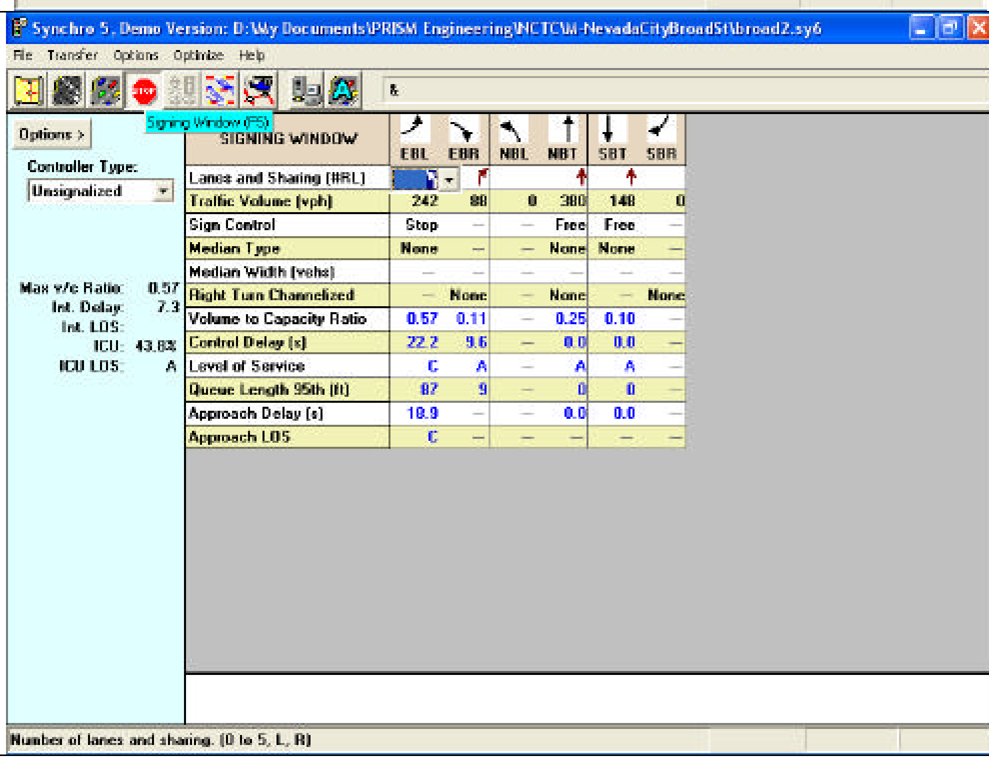


SIGNING WINDOW	EBL	EBR	NBL	NBT	SBT	SBR
Lanes and Sharing (#RL)						
Traffic Volume (vph)	242	88	0	380	148	0
Sign Control	Stop	—	—	Free	Free	—
Median Type	None	—	—	None	None	—
Median Width (vehs)	—	—	—	—	—	—
Right Turn Channelized	—	None	—	None	—	None
Volume to Capacity Ratio	0.57	0.11	—	0.25	0.10	—
Control Delay (s)	22.2	9.6	—	0.0	0.0	—
Level of Service	C	A	—	A	A	—
Queue Length 95th (ft)	87	9	—	0	0	—
Approach Delay (s)	18.9	—	—	0.0	0.0	—
Approach LOS	C	—	—	—	—	—

Proposed Conditions



SIGNING WINDOW	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lanes and Sharing (#RL)												
Traffic Volume (vph)	0	0	0	50	100	15	360	200	200	25	100	50
Sign Control	—	Stop	—	—	Stop	—	—	Stop	—	—	Stop	—
Median Type	—	None	—	—	None	—	—	None	—	—	None	—
Median Width (vehs)	—	—	—	—	—	—	—	—	—	—	—	—
Right Turn Channelized	—	—	None	—	—	None	—	—	None	—	—	None
Volume to Capacity Ratio	—	—	—	0.11	0.24	0.24	0.62	0.62	0.62	0.31	0.31	0.31
Control Delay (s)	—	—	—	9.5	10.5	10.5	15.8	14.8	14.8	11.3	11.3	11.3
Level of Service	—	—	—	A	B	B	C	B	B	B	B	B
Queue Length 95th (ft)	—	—	—	—	—	—	—	—	—	—	—	—
Approach Delay (s)	—	0.0	—	—	10.2	—	—	15.3	—	—	11.3	—
Approach LOS	—	A	—	—	B	—	—	C	—	—	B	—



SIGNING WINDOW	EBL	EBR	NBL	NBT	SBT	SBR
Lanes and Sharing (#RL)						
Traffic Volume (vph)	242	88	0	380	148	0
Sign Control	Stop	—	—	Free	Free	—
Median Type	None	—	—	None	None	—
Median Width (vehs)	—	—	—	—	—	—
Right Turn Channelized	—	None	—	None	—	None
Volume to Capacity Ratio	0.57	0.11	—	0.25	0.10	—
Control Delay (s)	22.2	9.6	—	0.0	0.0	—
Level of Service	C	A	—	A	A	—
Queue Length 95th (ft)	87	9	—	0	0	—
Approach Delay (s)	18.9	—	—	0.0	0.0	—
Approach LOS	C	—	—	—	—	—